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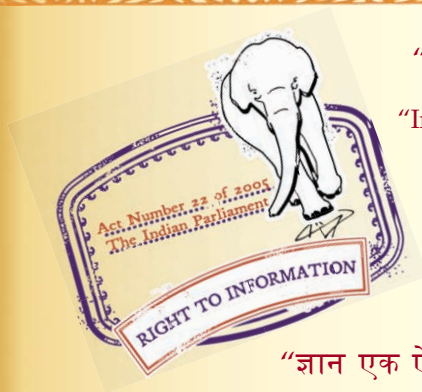
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IS 12291 (1987): Constant current regulators for airport Lighting systems [ETD 24: Illumination Engineering and Luminaries]



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Indian Standard

**SPECIFICATION FOR
CONSTANT CURRENT REGULATORS FOR
AIRPORT LIGHTING SYSTEMS**

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard

SPECIFICATION FOR CONSTANT CURRENT REGULATORS FOR AIRPORT LIGHTING SYSTEMS

0. FOREWORD

0.1 This Indian Standard was adopted by the Bureau of Indian Standards on 24 November 1987, after the draft finalized by the Illuminating Engineering and Luminaires Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Airport ground lighting systems are operated on a constant current (6.6 A or 20 A) supply fed from a constant current regulator. The regulator capacity should be adequate to provide for load and power loss in series circuit. Different types of constant current regulators are used employing resonant circuit, transducers, thyristors, etc. This standard covers requirements of all types of constant current regulators using the above principles in both higher and lower ratings.

0.3 In the preparation of this standard, assistance has been taken from Advisory Circular No. 150/5345-10 E (1984) issued by the Department of Transportation, Federal Aviation Administration, USA.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This specification covers the requirements for constant current regulators for use in airport series lighting circuits.

2. CLASSIFICATION

2.1 The various types of constant current regulators covered by this standard have been classified in Table 1.

3.1.2 Humidity — Relative humidity range from 10 to 100 percent.

3.1.3 Altitude — Any altitude from sea level to 3 050 m above sea level.

4. GENERAL REQUIREMENTS

4.1 Input Voltage — Input voltage shall be specified by the purchaser with a tolerance limit of +10 and -5 percent.

Regulators of 10, 15, and 20 kW may comply with the above criteria. As an alternative, resonant-type regulators smaller than 10 kW may be supplied with taps for 250, 240, 230, 220 and 208 V from which the proper tap may be selected for various supply voltages. The regulators shall be designed to withstand momentary increases of voltages up to 120 percent of the nominal input voltage without being shut off or damaged by such overvoltage. The duration of such overvoltage excursions shall be not longer than 50 milliseconds and shall occur no more than once in a 1 minute interval. External control power may be utilized if desired.

4.2 Circuit Isolation — The power input circuit shall be electrically isolated from the output circuit. The peak output voltage of an open-circuited regulator shall not exceed two times the rated wattage divided by the rated current or 4 250 V peak, whichever is greater. These measurements shall be made with an oscilloscope or high voltage peak reading meter.

**TABLE 1 CONSTANT CURRENT REGULATORS
CLASSIFICATION**

SIZE (kW) RATING	OUTPUT CURRENT		INPUT VOLTAGE	BRIGHTNESS STEPS	
	Type I 6.6 A	Type II 20 A		Style I 3 Step	Style II 5 Step
(1)	(2)	(3)	(4)	(5)	(6)
4	×		×	×	
7.5	×		×	×	
10	×		×	×	×
15	×		×	×	×
20	×	×	×		×
30		×	×		×
50		×	×		×
70		×	×		×

3. CONDITIONS OF USE

3.1 The constant current regulator shall be designed for continuous indoor operation under the following conditions.

3.1.1 Temperature — Temperature range of -20 to +55°C.

4.3 Primary Switch — The regulator shall have an integral remotely controlled primary switching device operated by the control voltage. The opening of this device shall not interrupt the power to the remote control.

4.4 Open-Circuit Protection — The regulator shall include an open-circuit protective device to open the primary switch within 2 seconds after an open circuit occurs in the secondary. The device shall reset within 2 seconds after the control switch is turned off and re-energized.

4.5 Overcurrent Protection — Regulators shall include an overcurrent protective device that opens the primary switch when the output current exceeds the nominal output current by 5 percent. The device shall operate within 5 seconds after an overcurrent of 5 percent and within 1 second after an overcurrent at 25 percent. The device shall reset within 2 seconds after the control switch is turned off and re-energized. The overcurrent protection shall not be activated by a momentary (0.25 seconds) overcurrent caused by switching off of load circuits or other transients.

4.6 Input Power Loss — In the event of a loss of input power long enough to effect regulator output current, the regulator shall resume operation on the selected brightness setting within 5 seconds after the restoration of the input power.

4.7 Electromagnetic Interference — The regulator shall cause minimum electromagnetic interference to other equipment such as computers, radars, instrument landing systems, radio receivers, very high frequency omnidirectional radio ranges, etc, which may be located on or near an airport, or may be supplied from the same power supply.

4.8 Remote/Local Control Switch — A multiposition selector switch to select remote, off, and local brightness control shall be located for ready access by an operator without opening the doors or removing the covers. The switch shall have detents, and the positions shall be marked 'Remote, Off, 10, 30, 100' for a three-step regulator and 'Remote, Off, 1, 2, 3, 4, 5' for a five-step regulator. The switch shall not rotate beyond an active position.

4.9 Output Ammeter — A flush-mounted, true rms-indicating ammeter to indicate output current shall be positioned on the front of the regulator so that it may be easily read. If analog, the meter shall have scale length equal to that of a 7.5 cm, round meter. The meter accuracy shall be at least ± 3.0 percent of the maximum output current.

4.10 Terminal Block and Wiring — A pressure-type terminal block having suitable voltage rating shall be installed in the control cabinet. This terminal block shall be suitable to accommodate 2.5 mm² copper-wire with an insulation rating up to 600 V terminals as shown below. At least two spare terminal block positions shall be provided in addition to those listed below.

Terminals *XCP* and *N* need be supplied only if external control voltage is used :

<i>Terminal Function</i>	<i>Label</i>
a) Power supply for remote control panel	<i>CCI</i>
b) Return from remote on/off switch	<i>CC</i>
c) Returns from remote intensity or switch (3 or 5 terminals provided)	<i>B1—B2—B3—B4—B5</i> <i>B10—B30—B100</i>
d) Input for external control power (optional)	<i>XCP</i>
e) Neutral for external control power (optional)	<i>N</i>

4.11 Regulator Enclosure — The reactors and/or transformer shall be housed in a sheet steel enclosure conforming to IP — 40 protection in accordance with IS : 2147-1962*. The enclosure shall be equipped with a removable cover that is held securely in place by capscrews or clamps. Feet or channels shall be attached to the bottom of the enclosure so that there will be no less than 5 cm of space between the bottom of the enclosure and the floor below it. Four enclosed terminations (two input and two output), suitable for the voltages involved, shall be located on the side or front of the enclosure with each pair labelled 'input' or 'output', as applicable. If the enclosure is an oil-filled tank, it shall be designed and fabricated to be oil tight, shall be equipped with a sampling and drain valve located not more than 5 cm above the bottom, and shall have a method or device to show the oil level. Lifting lugs shall be installed on the enclosure. Overall physical size of the complete regulator assembly shall be such that it will pass through an opening 1 m wide and 2 m high. A ground terminal shall be installed on the outside of the regulator enclosure. The regulator shall be shipped with the required amount of oil ready for service.

4.11.1 A suitable steel control cabinet or compartment for housing the relays, the sensing devices, the control terminal block, the remote/local control switch, and other low voltage control components shall be either permanently attached to or shall be an integral part of the enclosure. All low voltage control components shall be accessible by opening the cabinet. The cabinet shall close tightly in order to minimize the entrance of insects and airborne foreign material.

4.11.2 Capacitors — Capacitors shall be provided for power factor correction if required. Capacitors may be connected externally provided

*Degrees of protection provided by enclosures for low-voltage switchgear and control gear.

the terminals are enclosed when the equipment is installed.

4.12 Output Current Surge Limitation — The regulator shall be designed so that any output surges caused by switching the regulator on and off, changing brightness steps, or shorting the load will not damage series incandescent lamps. If time delay is utilized, not more than 2 seconds shall elapse from when the regulator is turned on to when the current is delivered to the load terminals. Pulsation or hunting of output current shall be limited to 5 seconds or less under all conditions of switching.

4.13 Wiring Diagram — A legible wiring diagram shall be permanently mounted in an unobstructed place in the control cabinet.

4.14 Painting and Finishing — The inside and outside of the enclosure shall be given one prime coat and one finish coat of oilproof and weather-proof paint. The outside of the enclosure shall be toughed up after assembly and testing is complete.

4.15 Lightning Arrestors — Lightning arrestors of the size necessary to protect the regulator shall be installed across the regulator output terminals. The ground side of the arrestors shall be connected to the grounding lug of the enclosure.

5. PERFORMANCE REQUIREMENTS

5.1 Regulation

5.1.1 Resistive Load Requirements — The regulator shall maintain the output current within the limits of Table 2 at any load between no load (short circuit) and full load. For regulators of 10 kW and larger, the regulation shall be maintained over the full range of environmental conditions specified in 3.1 and the input voltage range specified in 4.1. For regulators of less than 10 kW, the regulation shall be provided at nominal input voltage for all brightness steps.

TABLE 2 OUTPUT CURRENT
(Clauses 5.1.1, 5.1.2, 7.3, 7.3.1 and 7.3.2)

BRIGHTNESS STEP	NOMINAL RMS OUTPUT CURRENT, A	OUTPUT CURRENT LIMIT, A
(1)	(2)	(3)
	(Style I)	
3	6.6	6.40-6.70
2	5.5	5.33-5.67
1	4.8	4.66-4.94
	(Style II)	
5	6.6	6.40-6.70
4	5.2	5.04-5.36
3	4.1	3.98-4.22
2	3.4	3.20-3.50
1	2.8	2.72-2.88
	(Style II)	
5	8.3	8.05-8.43
4	6.5	6.30-6.70
3	5.1	4.95-5.25
2	4.3	4.17-4.43
1	3.7	3.59-3.81
	(Style II)	
5	20.0	19.40-20.30
4	15.8	15.33-16.27
3	12.4	12.03-12.77
2	10.3	9.99-10.60
1	8.5	8.24-8.76

5.1.2 Reactive Load Requirements — When the regulator is loaded with isolating transformers as described in IS: 12290-1987* and suitable lamps and the secondaries of 30 percent of the transformers are open-circuited, the output current shall remain within the limits given in Table 2. The load before opening the isolating transformer secondaries shall be any value from half to full load. For regulators of 10 kW or greater, the output current shall remain within the limits given in Table 2 for all brightness steps. For regulators of less than 10 kW, the current shall remain below 6.8 amperes for the 100 percent brightness step.

5.2 Efficiency — The efficiency of the regulator operated with rated input voltage into a full load having 100 percent power factor shall be not less than the value shown in Table 3.

TABLE 3 REGULATOR INPUT EFFICIENCY
(Clauses 5.2 and 7.6)

REGULATOR SIZE kW	MINIMUM OVERALL EFFICIENCY PERCENT
(1)	(2)
4	90
7.5	90
10	90
15	90
20	90
30	92
50	93
70	94

5.3 Power Factor — The power factor for regulators 10 kW or less in size shall be not less than 90 percent; for regulators larger than 10 kW, it shall be not less than 95 percent. The power factor shall be measured with the regulator operating on the maximum intensity setting, at rated input voltage, and into a rated resistive load.

5.4 Temperature Rise — The temperature rise of the regulator shall be in accordance with the limits specified in IS : 2026 (Part 2)-1977†.

5.5 Control System — The control system shall stabilize at any intensity setting within 5 seconds and shall hold the output current stable within ± 0.1 ampere at any output setting. The control system shall be designed for both local and remote control. Circuit lengths of 3 000 m shall use control cables having not less than 2.5 mm² cross section. Remote control of the system shall not affect the regulator performance characteristics. Voltage for the control system shall not exceed 120 V.

6. MARKING

6.1 Nameplate — Each regulator shall be marked with the following information accurately attached to the front of the regulator enclosure:

a) Constant current regulator, single phase;

*Specification for isolating transformers for airport lighting systems.

†Specification for power transformer: Part 2 Temperature-rise (first revision).

- b) Input Volts
Hertz Amperes;
- c) Control Volts Hertz;
- d) Output kW at Amperes;
- e) Output Current / /
Amperes. Litres of Oil ; and
- f) Identification: Serial No.

6.1.1 If the nameplate is attached to a readily removable surface such as a cover, the serial number shall be duplicated in a permanent conspicuous place elsewhere on the regulator.

6.2 Warning — A plate or decal with the following warning shall be affixed to the front of the regulator control cabinet door:

WARNING
REMOVE MAIN INPUT AND CONTROL
POWER BEFORE OPENING THE
COMPARTMENT

6.3 The regulator may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

7. TESTS

7.1 Classification of Tests

7.1.1 Type Test — The following shall constitute type tests:

- a) Visual examination (*see* 7.2),
- b) Regulation tests (*see* 7.3),
- c) Remote control test (*see* 7.4),
- d) Temperature rise test (*see* 7.5),
- e) Efficiency test (*see* 7.6),
- f) Power factor test (*see* 7.7),
- g) High temperature test (*see* 7.8),
- h) Low temperature test (*see* 7.9),
- j) Dielectric tests (*see* 7.10),
- k) Protective device tests (*see* 7.11),
- m) Transient suppression test (*see* 7.12),
- n) Leakage test (*see* 7.13), and
- p) Output current surge test (*see* 7.14).

7.1.2 Acceptance Tests — The following shall constitute the acceptance tests:

- a) Visual examination (*see* 7.2),

- b) Input voltage test (*see* 7.3.1),
- c) Efficiency test (*see* 7.6),
- d) Protective device tests (*see* 7.11), and
- e) Leakage test (*see* 7.13).

7.1.2.1 The sampling procedure and criteria of acceptance shall be subject to agreement between the supplier and the purchaser.

7.1.3 Routine Tests — The following shall constitute routine tests and shall be carried out on each regulator:

- a) Visual examination (*see* 7.2),
- b) Remote control test (*see* 7.4),
- c) Dielectric tests (*see* 7.10),
- d) Protective device tests (*see* 7.11), and
- e) Leakage test (*see* 7.13).

7.2 Visual Examination — Regulator shall not have any visible sign of damage. Compliance is checked by visual examination.

7.3 Regulation — The following tests shall be performed to demonstrate compliance with the requirements specified in 5.1 and Table 2. Where isolating transformers and lamps are not specifically required, a resistive load may be used.

7.3.1 Input Voltage Tests — For regulators 10 kW and larger, the regulator should be loaded to full load and energized with nominal input voltage, 110 percent of nominal voltage, and 90 percent of nominal voltage and the output current should be verified to see if it falls within the limits of Table 2. This test is repeated at half load and short circuit. These tests shall be repeated at all brightness settings. For resonant regulators under 10 kW, the regulator is energized with 250, 240, 230, 220 and 208 V and the output current is verified to see if it falls within the limits of Table 2. This test shall be conducted at short circuit, half load, and full load and at all brightness settings. Non-resonant regulators under 10 kW may meet either criteria.

7.3.2 Inductive Load Tests — For regulators 10 kW and larger, an equivalent of full load and half load shall be placed on the regulator, but with 30 percent of the isolating transformers open-circuited. The input voltages shall be nominal, 110 percent of nominal, and 95 percent of nominal voltage. The output current shall be checked at all brightness settings and shall be within the limits of Table 2. For regulators under 10 kW, the regulator shall be energized with 240 V and an equivalent of full load and half load on the secondary at the 100 percent brightness step. The secondaries of 30 percent of the isolating transformers shall be open-circuited, and the output current shall not rise above 6.8 amperes.

7.4 Remote Control Test — Check the output current at all brightness steps using the following remote control circuits (a resistance load may be used in lieu of the full length specified) and

rated output load:

- a) Connect the remote switch by simulated 30 m length of wire (a resistance equal to 0.16 ohms per wire). Operate the regulator remotely on all brightness steps to determine compliance with 5.5.
- b) Connect the remote switch by simulated 3 000 m lengths of control wire (a resistance equal to 87 ohms per wire and a capacitance between any two wires of 0.16 microfarads). Operate the regulator remotely on all brightness steps to determine compliance with 5.5.

7.5 Temperature Rise — Under consideration.

7.6 Efficiency — With nominal input voltage and a full load of unity power factor, the efficiency at maximum brightness shall not be less than that specified in Table 3.

7.7 Power Factor — With nominal input voltage and a full load of unity power factor, the power factor at maximum brightness shall be not less than that specified in 5.3.

7.8 High Temperature — Place the regulator in a test chamber and maintain the ambient temperature at $55 \pm 2^\circ\text{C}$. After the temperature of the regulator components has stabilized, operate the regulator for 4 hours at full rated input and output values. Perform the tests in 7.3.1 to demonstrate high temperature operation.

7.9 Low Temperature — Place the regulator in a test chamber and maintain the ambient temperature at $-40 \pm 2^\circ\text{C}$ for 12 hours. Perform the tests in 7.3.1 while maintaining a temperature of -40°C to demonstrate low temperature operation (remote control may be used).

7.10 Dielectric Tests — Test the circuits of a 1 regulator sizes to determine the equipment's ability to withstand the following rms, 60 Hz, test voltages for 1 minute without failure:

- | | |
|-------------------------------------|--|
| a) 240 V input circuit to ground | 2 000 V |
| b) 2 400 V input circuit to ground | 19 000 V |
| c) 120 V control circuits to ground | 1 000 V |
| d) 48 V control circuits to ground | 500 V |
| e) Output circuit to ground | 5 times
the full
load rms
voltage |

Lightning arrestors shall be disconnected during this test.

7.11 Protective Device Tests — Test all the protective devices for proper operation as specified in 4.4 and 4.5. Also test to determine the open-circuit voltage as specified in 4.2. Disconnect the open-circuit protection for this test.

7.12 Transient Suppression — To demonstrate the effectiveness of lightning arrestors, they shall suppress a test pulse on the output lines consisting of a 10 to 20 microsecond current surge of 15 000 amperes with the subsequent power-follow current and a voltage surge of 10 kW per microsecond, *Min* without damage to the regulator.

7.13 Leakage Test — Test each oil-filled regulator assembly to determine that all welds and gasketed seals are tight. Utilize an internal air pressure of $690 \pm 50 \text{ Nm}^2$ for 5 minutes.

7.14 Output Current Surge Test — The output of the regulator shall be checked to determine compliance with 4.13.

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